DOCUMENT RESUME

ED 232 128 CS 007 174

AUTHOR Glynn, Shawn M.
TITLE Cognitive Processes Involved in Text Learning.
PUB DATE Apr 83
NOTE 16p.; Paper presented at the Annual Meeting of the American Educational Research Association (Montreal, Canada, April 11-15, 1983).
PUB TYPE Viewpoints (120) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Cognitive Processes; Content Area Reading; Elementary Secondary Education; Higher Education; *Learning Theories; *Reading Comprehension; Reading Instruction; *Reading Processes; *Textbooks; Word Recognition
IDENTIFIERS *Reader Text Relationship

ABSTRACT

The comprehension of instructional text can be a cognitively demanding task because component comprehension processes compete for limited space within the readers' working memories. The component comprehension processes that readers must perform include recognizing words and retrieving their meanings, parsing sentences, identifying and organizing important text ideas, and integrating those ideas with prior knowledge. Readers cope with the limited capacities of their working memories by attending selectively, by organizing information hierarchically, and by automatizing to some degree their component comprehension processes through practice. Authors can help readers to comprehend and recall text information by making sure that the design of their texts supports each of the component comprehension processes that the readers must perform. (Author/FL)

**********
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
**********

ED232128

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
X This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

# Cognitive Processes Involved in Text Learning

Shawn M. Glynn

University of Georgia

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Shawn M. Glynn
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Paper presented at the meeting of the American Educational Research Association, Montreal, April 1983.

Symposium Title: Student Cognitive Processing of Instruction
Organizer: Sigmund Tobias

Send correspondence to:

Shawn M. Glynn
Department of Educational Psychology
325 Aderhold Hall
University of Georgia
Athens, Georgia 30602

CS 007 174

## Abstract

The comprehension of instructional text can be a cognitively demanding task because component comprehension processes compete for limited space in readers' working memories. The component comprehension processes that readers must perform include recognizing words and retrieving their meanings; parsing sentences; identifying and organizing important text ideas; and integrating those ideas with prior knowledge. Readers cope with the limited capacities of their working memories by attending selectively, by organizing information hierarchically,and by automatizing to some degree their component comprehension processes through practice. Authors can help readers to comprehend and recall text information by making sure that the design of their texts supports each of the component comprehension processes that the readers must perform.

## Overview

In most academic disciplines, the primary vehicles of formal and continuing education are textbooks, journals, and manuals. Since textual materials play such a vital role in education, it is important to study the processes that readers engage in when comprehending them and the processes that authors engage in when designing them.

Do devices such as advance organizers, instructional objectives, adjunct questions, and the like improve readers' comprehension and recall of instructional text? Not always. There are many reported instances where these devices have been found to have little or no effect on readers' comprehension or recall. The effect of these devices depends upon whether or not readers actually need them to comprehend a particular text. If readers are already adequately performing the process or processes that the device is intended to facilitate, then the device will be nothing more than excess baggage loaded on the text.

Unfortunately, some educators have been giving too much emphasis to particular devices and not enough emphasis to the processes supported by these devices. In a sense, these educators have been putting the cart before the horse. If educators want to increase the comprehensibility of the texts they write, they should examine the cognitive processes that readers perform when studying instructional texts, and they should make sure that the design of their texts support each of these processes.

It should be kept in mind that a given process can be supported in a variety of ways. There is really nothing special about any particular comprehension device. For example, if an author's purpose is to identify a particularly important idea for readers, this purpose can usually be achieved just as well by a typographical cue such as boldface as it can by a verbal cue such as an instructional objective.

In this paper, I will first discuss some of the cognitive processes that readers engage in when comprehending an instructional text. I will then discuss some of the familiar devices that authors use to support each of these processes. The main point of this paper is that authors can help readers to comprehend and recall an instructional text by making sure that the design of the text supports each of the component comprehension processes that the readers must perform.

## Cognitive Demands of Text Comprehension

The comprehension of instructional text can be a cognitively demanding task because the reader must call upon large bodies of relevant prior knowledge and use this knowledge to carry out concurrently a variety of component comprehension processes. These component comprehension processes include: recognizing the words in the text and retrieving their meanings, parsing the sentences those words are in, identifying the important ideas in the text, organizing those ideas, and integrating those ideas with prior knowledge (for studies of some of these processes, see Carpenter & Just, 1977; Thibadeau, Just, & Carpenter, 1982; Kintsch & Van Dijk, 1978; Miller & Kintsch, 1980) When these processes are carried out successfully, they produce the cognitive structures that are the desired end products of text comprehension (see Tobias, 1982). On the other hand, if one or more

of these processes is not carried out successfully, comprehension will break down. If comprehension breaks down, the reader will either fail to understand certain text ideas or will misunderstand them.

The reader's relevant prior knowledge and component comprehension processes both compete for limited space in the reader's working memory system. In this system, information that is currently being attended to is maintained temporarily through the process of rehearsal. While maintaining this information, the reader operates on it in different ways and integrates it with other items of related knowledge that have been retrieved from the reader's long-term memory system. In a sense then, the reader's working memory functions as a workbench. The novel products of the operations and integrations performed on this workbench are stored away in the reader's long-term memory system.

Readers cope with limited capacities of their working memories in a number of ways. One of the ways they cope is by allocating their attention differentially to text information, giving the most important information the most attention. Another way they cope is by organizing information into hierarchically related conceptual categories. Still another way they cope is by automatizing to some degree their component comprehension processes through practice.

## Supporting Component Comprehension Processes

I will now review briefly some of the familiar devices that authors use to support each of the component comprehension processes.

Recognizing Words and Recalling Their Meanings

Authors support readers' performance of this process by making sure that the vocabulary of the text is appropriate for the audience in question. If a text contains unfamiliar words, then some readers will find the text difficult to comprehend.

In a set of experiments conducted by Bruce Britton, myself, Bonnie Meyer, and Margery Penland (1982), we asked college students to read texts which were similar in meaning, but which varied in terms of the frequency of vocabulary words used in them. For example, the familiar word "people" was used in the version with high-frequency vocabulary words, whereas the less familiar work "populace" was used in the version with low-frequency vocabulary words.

In these experiments, there were three measures of performance: recall, reading time, and cognitive capacity use. Cognitive capacity use refers to the amount of processing effort that a reader is putting forth (see Britton, Holdredge, Curry, & Westbrook, 1979). The use of cognitive capacity was measured by means of the secondary-task technique: that is, decreases in performance on a secondary task were used to measure increases in the use of cognitive capacity on a primary task. The primary task was reading a text and the secondary task was reacting to occasional, unpredictable clicks. A student sat at a table reading a text with a finger on a telegraph key. When a click was heard, the student released the key as quickly as possible. The time (in ms.) between the occurence of the click and the release of the key was the measure of secondary task performance. The longer the student took to respond to the click, the more capacity was

assumed to be in use during reading.

We found that the students who read the version of the text with the the familiar words recalled more information, read faster, and used less cognitive capacity than the students who read the version with the less familiar words. Of course, these findings do not imply that authors should write instructional texts using only one- and two-syllable vocabulary words. Rather, they imply that authors should be careful to use vocabulary words that are appropriate to the reading level of their audience.

Parsing Sentences

Readers must apply rules of grammar to the words, phrases, and clauses that make up sentences in order to comprehend the meaning of those sentences. One of the ways that authors help readers to parse sentences is by making sure that the syntax of those sentences is not unnecessarily complex.

In some of the experiments I mentioned earlier (Britton et al., 1982), the meaning of a text was held approximately constant while the syntactic complexity of the sentences in that text was increased by transforming the verbs in active voice to passive voice, and by combining the simple sentences to form compound and complex sentences. The text was an adaptation of one used by Rothkopf and Coatney (1974) called Geography and History of Thailand. To illustrate, two of the sentences in the simple-syntax version of this text were:

> The people of this truly colorful country have from their very earliest days called themselves "Thai" (free). And the land in which they live, they themselves call "Muang Thai" (land of the

free).

In the complex-syntax version, these two sentences were transformed into one that read:

> The people of this truly colorful country have, from their very earliest days, called themselves "Thai" (free), and the land in which they live, they themselves call "Muang Thai" (land of the free) or "Prathet Thai" (country of the free).

Once again, the dependent measures were recall, reading time, and cognitive capacity use (as measured by secondary-task reaction time). We found that the students who read the version of the text with the simple syntax recalled more information, read faster, and used less cognitive capacity than the students who read the version with the unnecessarily complex syntax.

These findings do not suggest that authors should write only simple sentences. They suggest, instead, that authors should use the syntactic structures that most precisely convey they ideas at hand. Simple sentences are used to convey ideas that are largely independent of one another. Complex and compound sentences, on the other hand, are used to convey ideas must be integrated in order to be meaningful.

## Identifying The Important Ideas In The Text

Authors use a variety of devices to help readers identify the most important ideas in an instructional text. Of course, one of the most popular of these devices is to introduce each chapter with a list of instructional objectives. Instructional objectives are learning goals. They can take the form of either statements or

questions, and their function is to point out the important information that the readers should search for and commit to memory.

It is well established that the provision of instructional objectives increases the learning of text information relevant to the objectives (Frase & Kreitzberg, 1975; Glynn & Di Vesta, 1979; Rothkopf & Koether, 1978). When study time is fixed, the objective-relevant information acquires its recall advantage at the expense of the objective-irrelevant information.

Instructional objectives are beneficial then because they help readers to allocate their attention differentially to text ideas. The ideas cued by the instructional objectives are processed more extensively than those which have not be cued. These cued ideas can be processed extensively by rehearsing them, by integrating them with relevant prior knowledge, and by constructing visual images of them and verbal mnemonics for them.

Within the text itself, authors cue readers to particularly important ideas by introducing these ideas by signal phrases such as "it is noteworthy that," "an important point is that," or "keep in mind that" (Meyer, 1975). In addition, within a text, authors use typographical cues such as italics, boldface, color, boxes, and "white space" to call particularly important ideas to readers' attention (Glynn, 1978; Glynn, Britton, & Tillman, in press). When used sparingly, signal phrases and typographical cues selectively increase readers' recall.

Organizing Text Ideas

The sequence of ideas within sections of an instructional text usually approximates a hierarchical organization, with the most

important ideas being at the top of the hierarchy. Authors support readers' efforts to organize text ideas by making explicit the inherent hierarchical organization of a text.

When authors introduce a chapter with a brief hierarchical outline of the major ideas that will be covered in it, they make the inherent organization of their chapter explicit. In a study I conducted with Frank Di Vesta (1977), college students were asked to study instructional texts which varied in terms of the degree to which they approximated a hierarchical organization. As you might expect, the students were able to recall the well organized texts much better than the poorly organized texts. We were able to improve students' recall of the poorly organized texts considerably, however, by asking the students to first study brief hierarchical outlines of the topics discussed in those texts. The outlines helped the students to organize the text content into hierarchically related conceptual categories.

Within a text chapter, authors use headings to make the organization of the chapter explicit. Headings summarize in a few words the major topics of a chapter. In addition, the spatial cues associated with center, side, and paragraph headings help readers to identify the superordinate-subordinate relationships that exist among topics. Headings can decrease reading time and the time it takes to search for topics; headings can also increase readers' recall of the content subsumed by the headings (Hartley & Trueman, 1982).

Integrating Text Information with Relevant Prior Knowledge

If items of text information are integrated with one another and with relevant prior knowledge, the product that results will be both meaningful

and memorable. Authors sometimes support readers' performance of the integration process by using advance organizers to introduce text chapters. The information in an advance organizer is intended to be at a higher level of abstraction, generality, and inclusiveness than the information in the text itself. According to Ausubel (1977), "the principal function of the organizer is to bridge the gap between what the learner already knows and what he needs to know before he can successfully learn the task at hand" (p. 168). I encourage anyone who wants to design effective advance organizers to examine some excellent examples collected by Weil and Joyce (1978). Their examples cover content areas such as geography, history, anthropology, biology, and English.

Authors sometimes support the integration process by asking readers to answer conceptual, or inferential, adjunct questions (Rickards, 1976). Such questions are answered by combining text ideas together to form higher-order ideas.

Finally, authors sometimes support the integration process by using analogies to explain new concepts or principles they discuss in their texts (Royer & Cable, 1976). For example, the author of a biology text who compares the brain to a computer, the eye to a camera, or the heart to a pump, is capitalizing on the readers' prior knowledge. Even though the analogies are flawed in some respects, they still can be a great aid to comprehension.

## Summary

In summary then, the comprehension of an instructional text can be a formidable task because the component comprehension processes that the readers must perform compete for limited space in the readers' working memories. The main point of this paper was that authors can reduce the cognitive demands imposed on readers by making sure that the design of

their texts supports each of the component comprehension processes that the readers must perform.

## References

Ausubel, D. P. The facilitation of meaningful verbal learning in the classroom. Educational Psychologist, 1977, 12, 162-178.

Britton, B. K., Glynn, S. M., Meyer, B. J. F., & Penland, M. J. Effects of text structure on use of cognitive capacity during reading. Journal of Educational Psychology, 1982, 74, 51-61.

Britton, B. K., Holdredge, T. S., Curry, C., & Wesbrook, R. D. Use of cognitive capacity in reading identical texts with different amounts of discourse level meaning. Journal of Experimental Psychology: Human Learning and Memory, 1979, 5, 262-270.

Carpenter, P. A., & Just, M. A. Integrative processes in comprehension. In D. LaBerge & S. J. Samuels (Eds.), Basic processes in reading. Hillsdale, NJ: Lawrence Erlbaum Associates, 1977.

Frase, L. T., & Kreitzberg, V. S. Effect of topical and indirect learning directions on prose recall. Journal of Educational Psychology, 1975 67, 320-324.

Glynn, S. M. Capturing readers' attention by means of typographical cuing strategies. Educational Technology, 1978, 18(11), 7-12.

Glynn, S. M., Britton, B. K., & Tillman, M. H. Typographical cues in text: Management of the reader's attention. In D. H. Jonassen (Ed.), The technology of text (vol. 2). Englewood Cliffs, NJ: Educational Technology Publications, in press.

Glynn, S. M., & Di Vesta, F. J. Outline and hierarchical organization as aids for study and retrieval. Journal of Educational Psychology, 1977, 69, 89-95.

Glynn, S. M., & Di Vesta, F. J. Control of prose processing via instructional and typographical cues. Journal of Educational Psychology, 1979, 71, 595-603.

Hartley, J., & Trueman, M. Headings in text: Issues and data. Paper presented at the 20th International Congress of Applied Psychology, Edinburgh, July 1982.

Kintsch, W., & van Dijk, T. A. Toward a model of text comprehension and production. Psychological Review, 1978, 85, 363-394.

Meyer, B. J. F. The organization of prose and its effects on memory. Amsterdam: North Holland Publishing Company, 1975.

Miller, J. R., & Kintsch, W. K. Readability and recall of short prose passages: A theoretical analysis. Journal of Experimental Psychology: Human Learning and Memory, 1980, 6, 335-354.

Rickards, J. P. Interaction of position and conceptual level of adjunct questions on immediate and delayed retention of text. Journal of Educational Psychology, 1976, 68, 210-217.

Rothkopf, E. Z., & Coatney, R. P. Effects of readability of context passages on subsequent rates. Journal of Applied Psychology, 1974, 59, 679-682.

Rothkopf, E. Z., & Koether, M. E. Instructional effects of discrepancies in content and organization between study goals and information sources. Journal of Educational Psychology, 1978, 70, 67-71.

Royer, J. M., & Cable, G. W. Illustrations, analogies, and facilitative transfer in prose learning. Journal of Educational Psychology, 1976, 68, 205-209.

Thibadeau, R., Just, M. A., & Carpenter, P. A. A model of the time course and content of reading. Cognitive Science, 1982, 6, 157-203.

Tobias, S. When do instructional methods make a difference? Educational Researcher, 1982, 11, 4-9.

Weil, M., & Joyce, B. Information processing models of teaching. Englewood Cliffs, NJ: Prentice-Hall, 1978.